

JOURNAL  
OF THE  
WASHINGTON ACADEMY OF SCIENCES

VOL. 31

JANUARY 15, 1941

No. 1

PALEONTOLOGY.—*The role of the individual in evolution.*<sup>1</sup>  
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"All is for individuals."<sup>2</sup>

Whatever happens in organic evolution, or indeed within the whole realm of the biological sciences, happens to an individual. Genetic mutations occur in individuals. Individuals struggle for existence and fail or succeed according to their equipment and circumstances. It is individuals that reproduce and that exercise such selection of a mate as may be possible to them. These facts are so evident that it may not seem worth while to state them, and similar statements so exhaust the basic aspects of evolutionary theory that it may seem impossible to say more about the role of the individual in evolution. Nevertheless such statements of the obvious are not needless, because the obvious is so often forgotten, nor do they exhaust the subject, because it has scientific, philosophical, and social ramifications that are both subtle and complex.

Difficulty is encountered at the outset in attempts to define an individual. I am sure that I am an individual, and I am willing to grant the same status to a dog, an oyster, or a pine tree. This apparently simple concept, however, begins to encounter difficulties if a colonial coral is considered and to break down altogether on the problem of whether a lymphocyte is an individual. There are different categories of individuals and different degrees of individuality. Their classification and definition could be discussed for hours, and the discussion would probably produce more obscurity than light. Let us avoid this confusion by using the word "individual" in a commonplace sense as an organically continuous living structure capable of reacting independently and as a whole.

There has been evolution toward more and toward less individual-

<sup>1</sup> Address delivered before the Paleontological Society of Washington, November 20, 1940. Received November 30, 1940.

<sup>2</sup> The section epigraphs are all from Walt Whitman's poem "As I Sat Alone by Blue Ontario's Shores."

ity. A solitary protozoan, such as an amoeba, is fully individual under our definition, but one cell of a protozoan colony, as in *Volvox*, is less individual. As metazoans arise by cellular differentiation, the protozoan individuality of the single cell is effectively lost, and the metazoan structure becomes itself fully individual in the same sense as the solitary protozoan but on a new and different level. In colonies of essentially similar but organically continuous metazoans, as in many corals, the metazoan individuality begins to merge into one of different level. Finally a stage may be reached, as in *Physalia* and its allies, in which the united metazoan zooids are differentiated in function and structure and have almost entirely abdicated their individualities in favor of what might be called a hyperzoan individuality. Here there appears to be a true emergence of individuality belonging to the colony rather than to the zooids, in the same way that metazoan individuality belongs to the animal and not to its constituent cells.

Hyperzoan individuality is a rare evolutionary development. The vast majority of living things have stopped short at the metazoan level, and their further progressive evolution has been an intensification of individual integration and complication on that level. This is preëminently true of the vertebrates and among them of the line leading to man, which has shown neither the trend nor the potentiality of developing hyperzoan individuality. Certain social groups, particularly among insects, present evident analogies with hyperzoan individuals, and there has been a strong recent tendency to consider human society as possessing this sort of individuality, but in a biological sense this is wholly false except as a figure of speech. One level of individuality can arise only to the degree that the subordinate level is suppressed. Most animal and all human social groups are collectivities the members of which retain complete metazoan individuality.

This distinction between group and individual is fundamental and has implications of the greatest importance, extending even into the political sphere. The subject will be developed further in the following pages, and these implications will be explored when a broader basis for them has been laid.

#### THE INDIVIDUAL, DARWINISM, AND GENETICS

*"For the great idea, the idea of perfect and free individuals."*

In a Lamarckian view of evolution, the individual is all-important. He is the master of his fate in the broadest sense, and individual activities may wholly determine the course of evolution. The individual acts, learns, and strives; his characteristics are thereby altered, and

some part of this modification is transmitted to the next generation. This theory dies hard, and paleontologists seem inclined to cling to some aspects of it more than neobiologists, but it probably must be abandoned. No means for the transmission of such individually acquired modifications have been discovered, and long experimentation has failed to reveal unquestionable evidence of its real occurrence. It now appears that new characters can arise only in the germ plasm and that their rise is little or not influenced by any purely individual factor.

Under more strictly Darwinian theories and the genetic theories that partly supplement and partly supplant Darwinism, new characters in phylogeny arise at random, at least in the sense that their appearance is sporadic and that the present state of our knowledge does not enable us to predict them individually. The individual seems at first sight to have little to do with evolution under these circumstances, which make the emergence of novelty seem as impersonal as the fatality of a bolt of lightning striking a crowd. It may be only ignorance that makes us think that this is true, but even if it be granted, the individual is still left an essential role in evolutionary theory. The fate of mutations and their genetic combination and segregation are aspects of evolution quite as important as their origin and more approachable, and here the individual is highly important.

The Darwinian theory of natural selection is often presented as primarily a pruning process. Given the fact that hereditary variation occurs, whatever its basis and origin, this viewpoint is that the direction of evolution is largely controlled by negative factors: by the elimination of some variations, singly or in combination. Even those geneticists who are least neo-Darwinian usually recognize selective elimination as one crucial factor in evolution. Here the individual's role is stellar but tragic. His essential part in evolution is to die. If selection is operative, death is not a random occurrence in which the individual counts for nothing, but must be correlated with individual characteristics and the study of the selective process must be directed toward individuals.

Some individuals are always less fit than others, or carry genes that are deleterious under the environmental conditions available to the species. As Dobzhansky says, "It is the loss of these individuals that guards the species as a whole from extinction." And he adds, "The general picture of the mechanism of evolution thus arrived at will certainly be far from pleasing to those who regard nature as an embodiment of kindness. The writer must confess that this picture is

not pleasing to him either. The words 'good' or 'bad' are not to be found, however, in the scientific lexicon."

The selective process, however, is not concerned with elimination only, and gloomy concentration on the death of the individual and the extinction of the species leaves out what Darwin himself so well emphasized as the essence of natural selection, that is, the survival of the fittest. It is no truer to say that the individual's role is to die than to say that its role is to survive. The species is a sum or collectivity of individuals, and it is an entity only in this sense, not in the sense of having a sort of superindividuality. Its survival similarly is the sum of individual survivals. Survival, along with reproduction, which is an aspect of survival, is the individual's business.

The individual's role here, one might say his duty if the word can be used without anthropomorphic implications, may be represented in terms of striving to obtain satisfaction. On the lowest level, active bodily metabolism and reproduction have come to be basic satisfactions, simply because they do have this survival value. It may be objected that satisfaction is an emotion and that the vast majority of living organisms feel no such thing, but the difficulty is semasiological rather than conceptual. In every living thing there is at least an impulsion or need that is eased by such fulfillment, and satisfaction is as good a word as any to use for this phenomenon. The connotation is not necessarily emotional any more than in saying that a certain value of  $x$  "satisfies" an equation. It is legitimate to speak of a tree, for instance, as satisfied by maintaining its organism in the vital state and by producing fertile seeds. On the higher animal levels these biological satisfactions, although fundamentally the same, tend to become conscious and finally do acquire truly emotional value.

From this point of view, it can be said that the species prospers to (and only to) the extent that individuals attain satisfaction, and that the species is modified because some heritable characteristics assist more than others in the striving for individual satisfaction. The nature of the satisfactions operative within a given species is also heritable and subject to evolution. This appears to be quite the opposite of the view that the greatest thing individuals do for a species is to die, for death is the antithesis of individual satisfaction. Some may declare with Tennyson that nature (or evolution) does not really act this way,

*So careful of the type she seems,  
So careless of the single life.*

Entomologists may insist that social insects habitually behave for

the good of the group and not for individual satisfaction, and some sociologists maintain that the sacrifice of individual satisfaction is the highest human trait and the only hope for human progress. It is, I think, a mistake to suppose either that insects do or that humans should prefer group satisfaction to individual satisfaction. The apparent anomaly is explicable by the fact that two distinct broad categories of individual satisfaction have survival value. In one case the satisfaction lies in belonging to and serving the group. It arises in the individual but as the result of an extrinsic or environmental situation.

Mutations tending to make individuals prefer extrinsic to intrinsic satisfaction have been called altruistic, for instance by Haldane, who has studied them from a neo-Darwinian genetic point of view. As Haldane has pointed out, however, what we call altruism in man frequently is not altruistic in this biological sense, nor is such biological "altruism" necessarily eugenic and its opposite dysgenic. The biological factor is not forgetfulness of self in service to others, negation of the individual, as altruism is supposed to be, but is self-satisfaction on an individual basis by means which do, as result rather than intention, tend to sacrifice the individual to the group.

Genetic emphasis on extrinsic satisfaction is unlikely to arise in large or in cross-breeding groups, and it is unlikely to have survival value for the species unless it is confined to one caste, like the neuters among social insects, while another caste, like the queens among these insects, is dominated by intrinsic satisfactions. A species in which only extrinsic factors gave individual satisfaction would be doomed to almost immediate extinction under any ordinary conditions and such a species probably could not arise. On the other hand, individuals dominated by intrinsic satisfaction, or belonging to species in the evolution of which this has the major survival value, frequently also experience extrinsic satisfactions and the conflicts and coordinations of the two give rise to some of the most elaborate forms of behavior and to some of the most complex evolutionary developments, including those of men.

In another respect the individual is a fundamental factor in the fate of genetic modifications once these have arisen. The spread of a mutation through a species (or interbreeding group), its survival or extinction, its equilibrium point, and its combination with its various allelomorphs are all functions of the number of individuals comprising the group, as has been well demonstrated by Wright, Fisher, and Haldane, among others. This aspect of the subject is somewhat aside

from the main theme of the present discussion, but in passing it is desirable to emphasize one point, familiar to geneticists but less so to paleontologists, whom it most directly concerns.

Rapid evolution and evolution involving complex new structures or fundamental reorganizations of structure depend on many factors. Some of these factors are still quite unknown, but it seems certain that the number of interbreeding individuals is one of them. It is theoretically probable and as far as observation is possible it appears to be the fact that large groups of individuals evolve relatively slowly and are less likely than smaller groups to develop any fundamental structural changes. If a paleontologist has a large number of specimens of a given group, this is usually in itself evidence that the group, when alive, was rich in individuals. Such groups do, of course, give legitimate evidence of some of the modes of evolution, but these modes may be quite different both quantitatively and qualitatively from those of groups that included fewer individuals and that are therefore rare or absent in paleontological collections. It is, then, necessary to be cautious in generalizing from such groups as the known fossil horses. It is probable that "laws of evolution" deduced from this series do not apply to the individually less abundant (and in this case still quite unknown) animals that first acquired the basic perissodactyl structures. This numerical factor may be the real reason for many of the sudden breaks and supposed leaps in the paleontological record, often explained in very different ways. It is almost surely the reason why many paleontologists have believed that evolution normally progresses with great regularity and in straight lines.

#### THE INDIVIDUAL AND EVOLUTIONARY FATALISM

*"We are executive in ourselves—We are sufficient in the variety of ourselves."*

Whatever the personal philosophy of the student, the usual approach to the practical study of evolution has been deterministic and mechanistic, or physical in a sense that has been abandoned by many physicists. In its extreme expression, as developed by some nineteenth century workers, this attitude is that if the distribution and state of all the matter and energy in the universe at a given instant were known and if all the immutable physical laws of causation were likewise known, then everything that would ever occur after that instant could theoretically be predicted. This stern creed is emotionally distasteful to most men, and it involves a number of serious logical and philosophical difficulties. It has been subject to repeated attack, and in various spheres there has been a strong reaction against it.

As far as these attacks have originated in theology, in vulgar misapprehension, or solely in emotionalism they do not concern us here, but in many cases they have been led by scientists and have taken the form of alternative scientific theories. In the physical sciences determinism has tended to give way to "uncertainty relations" and to a so-called statistical view of natural law. Some physicists have strayed so far from the field of the determinate and the classically mechanical that they have imagined themselves face to face with God and have set up as scientific theologians, as which they cut rather sorry figures.

In the biological sciences a somewhat similar position has been reached by different paths. Life activities are superficially so unlike most inorganic activities that it is tempting to think of life as something fundamentally nonmechanical. From this it is an easy step to the conviction that the essence of life, its real distinction from the nonliving, does not reside in any feature of physical organization but in something nonphysical or metaphysical. So the biologist reaches a conclusion suggestive of the theological distinction of body and soul, although he demands his own definition of "soul" and generally refuses to give it that name. If this distinction is valid, then there is no reason for believing that evolution and the life processes in general are mechanical sequences, and it is possible to maintain that they are modified or controlled by impalpable forces without any material basis or directly material manifestation. One eminent paleontologist has endowed these forces with some degree of personality and seriously maintains that evolution has been directed by spirits of limited intelligence and diverse intentions. This miscegenation of modern science and medieval demonology is perhaps the most extraordinary recent development of scientific philosophy, but it is an extreme, not wholly illogical, toward which much recent biological thought tends.

A related line of development of evolutionary theory has in some respects been curiously opposite to the drift of physical theory from determinism to indeterminism. A basic premise of Darwinian evolution was the existence of random variation. A more recent school of thought insists that random variations (even if heritable) have had little or no significance in evolutionary history and that evolution has followed definite predetermined and theoretically predictable lines regardless of random fluctuation. Such a descriptive theory of the course of evolution is capable of a mechanistic or even of a purely Darwinian causal explanation, but as it has been most energetically advanced (especially by Osborn) it is essentially metaphysical. When the conception of a goal is added, this metaphysical basis becomes still more evident,

and the extreme is reached with teleological judgments of the goodness or badness of mutations.

These two broad trends of thought, one maintaining that causation in evolution may be largely nonphysical and the other that evolution is a continuous, nonfluctuating sequence with a predetermined outcome, contrast in many ways but they are compatible (frequently being combined in the theoretical conclusions of a single student) and they are alike in this: that they lead to a sort of evolutionary fatalism. They reject the conclusion of Darwinism and of various other theories that the products of evolution are the results of a sequence of accidents—not accidents in the sense of things happening entirely at random but in the sense of occurrences mechanically produced by complex concatenations of circumstances, not intended and not foreordained and subject to change of direction with any change in the circumstances. In the place of this concept, the adherents of entelechy, aristogenesis, and the like maintain that evolution consists of progression toward some ideal. They feel that the products of evolution were intended, in some metaphysical sense, and they replace accident by fate.

The bearing of these philosophical considerations on the role of the individual in evolution is direct and crucial. It has been shown that under the Darwinian and the usual genetic theories, the activities and satisfactions of the individual are determining factors in the course of evolution. According to the theories of evolutionary fatalism, on the other hand, the individual does not matter unless, possibly, to himself. The direction and rate of evolution should be independent of individual factors. The transition from *Eohippus* in the Eocene to *Equus* in the Recent is considered as an orthogenetic inevitability, and all that the myriads of individuals in the sequence had to do with it was to exhibit the structures involved and to produce the succeeding generations. The same attitude toward the individual arises, *a fortiori*, in the still more metaphysical theories that assume a universal organizing force, a sort of world-soul, or spiritual guides and innovators.

As purely philosophical problems, these questions are as complex and as nearly insoluble as the question of free will, and their discussion on that basis would be as futile. As scientific theory, I find that I have here called fatalistic evolution quite untenable. Its strongest evidence has been drawn from the field with which I am most familiar and is seen in the phenomenon commonly called orthogenesis. As straight verbal description of what has happened in a few particular instances, orthogenesis and similar paleontological inferences are valid and use-



ful. As theoretical generalizations of the mode of evolution, and still more as bases for metaphysical speculation on the causes of evolution, they are not valid, or at least not in the sense of justifying fatalistic placing of the individual in the scheme of things. The lines that give evidence of orthogenesis are all individually abundant groups, regarding which necessary caution has already been enjoined. The structural changes involved are all genetically very simple in comparison with those involved in the major events of evolutionary history. They can be well explained in purely mechanistic genetic terms, with no recourse to orthogenesis in any metaphysical sense.

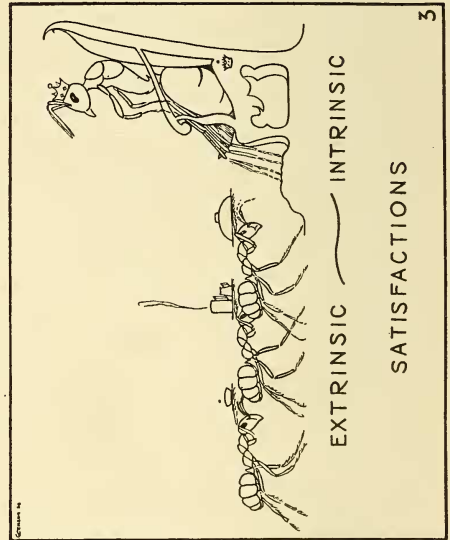
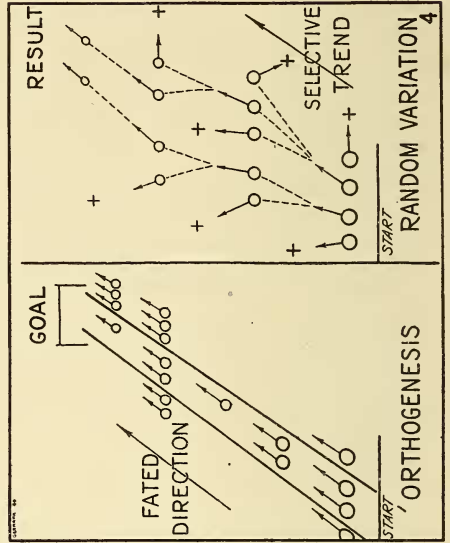
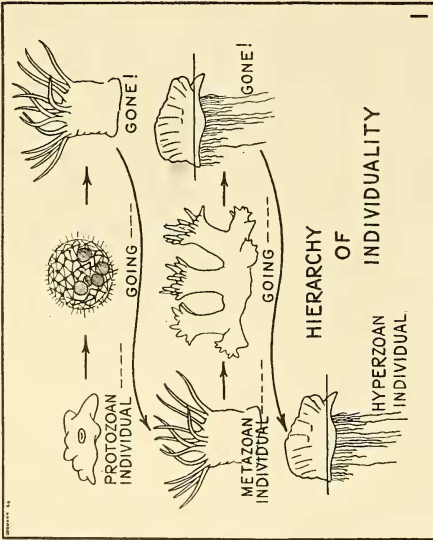
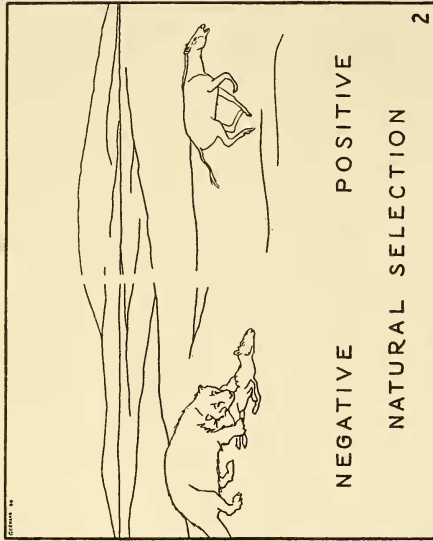
The individual is a pawn of fate only to the extent that his inheritance is not and his environment is only in part of his own making. These come to him as a result of past causes, not as presage of future destiny. Within this framework, so largely wrought by the actions and interactions of previous individuals in the enormous web of life, the individual makes his own fate and that of the species composed of him and his fellows.

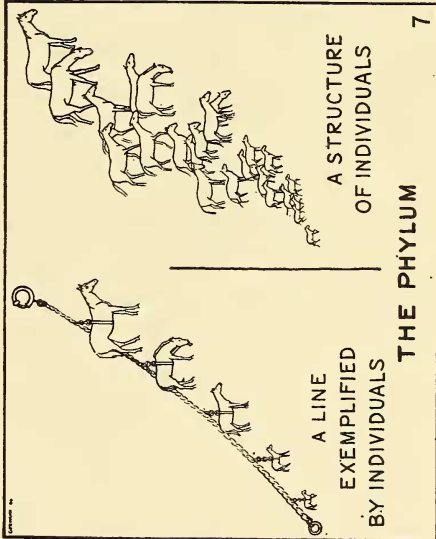
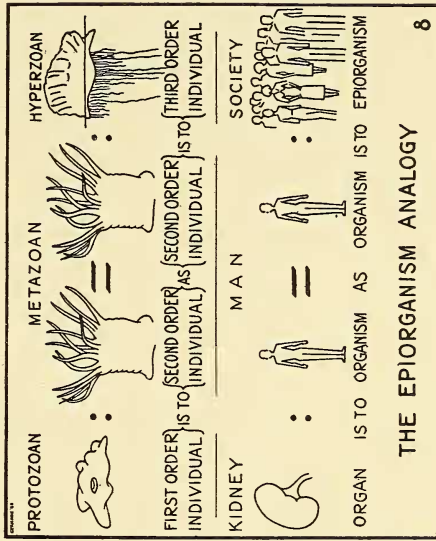
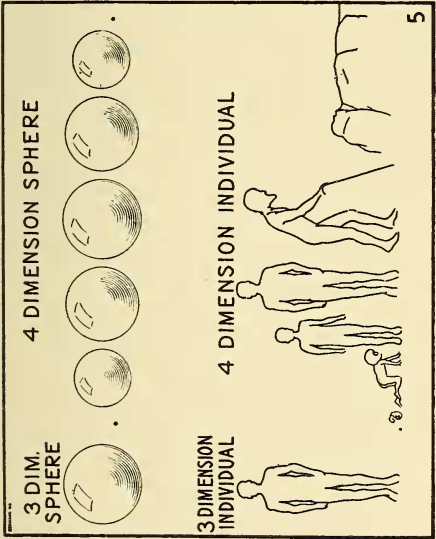
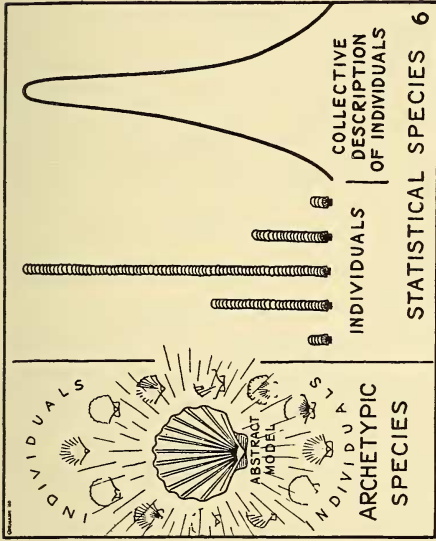
#### THE INDIVIDUAL AND THE FOURTH DIMENSION

*"I swear nothing is good that ignores individuals."*

Among the most significant trends in zoology and paleontology are the increasing use of dynamic concepts and study of dynamic problems. The most limited and formerly the most common sort of work in these fields consisted of the examination and comparison of a supposedly representative, dead individual of any given species. The zoologist studied animals that had been dead for a few months or years and the paleontologist studied animals that had been dead for hundreds of thousands or millions of years: the technique is different, in part, but the approach is the same. Now both zoologists and paleontologists, each in the ways permitted by their materials, are more likely to study animals as functional, active organisms and not only as static morphological exhibits. This shift in emphasis has given rise to a new concept of the individual and to a new orientation of the individual in the scheme of things.

The dynamic concept of the individual is four-dimensional. An individual is not a certain combination of tissues arrested at a moment in time, but is the whole sequence of states and forms through which one animal passes from the fertilized ovum to death. That this seemingly obvious fact really represented a new viewpoint in the biological sciences is shown by the radical changes brought about by it in the recapitulation theory during the past 20 years. Although based on the





superficially dynamic idea of a succession of structural stages, Haeckel's so-called biogenetic law was fundamentally static. It really conceived of the individual as a motionless and timeless adult structure and achieved the illusion of motion (like a moving picture) by a succession of stills. Garstang has shown the true nature and limits of recapitulation in terms of a dynamic individual, inheriting not merely its adult structure but its whole life cycle from its ancestors and showing modifications in every part of that cycle effected by the same sort of hereditary and evolutionary factors as those influencing the final, static form.

Analogous dynamic concepts have been applied in the consideration of groups and of the relationships of individuals to groups. The philosophical zoologists of the late eighteenth and early nineteenth centuries, such as Goethe, Oken, and Owen, developed the theory of archetypes as ordained patterns more or less closely followed by individuals. As a thousand freehand sketches from the same model would vary, so do individuals vary from the archetype, but the variations have no significance for the study of the essential, the philosophical reality, which is the model and not the individual sketch of it.

The spread of evolutionary zoology led to the abandonment of the philosophical concept of archetypes, but the static point of view involved in it was not immediately discarded and indeed persists to considerable degree today. The diagnosis of taxonomic groups by statement of a combination of fixed characters believed to be common to all members of the group is almost exactly the same process as the delineation of an archetype, however different in intention and interpretation. It relegates the individual to the same insignificant role, attempting, not the simultaneous description of a group of individuals, but the abstraction from them of all that is not individual.

A newer and, I think, incomparably truer and more profitable point of view is making rapid headway although still far from universal recognition. This is that the group is best definable as a collection of individuals and not as an abstraction of the nonindividual. This does not mean that the group is to be defined on the basis of one or a few individuals, a fault rather of the old, static, pseudo-archetypal taxonomy than of the new, dynamic, statistical taxonomy. On the contrary, full definition in the newer sense requires the examination and use of more individuals. If only one is available, the group definition or concept derived from it must be more loosely drawn; the unique specimen is not an example of an archetype but one of a collectivity of individuals

and due allowance must be made for the probable varying characteristics of the unknown individuals of the group.

According to this concept, the differences between individuals are as much characters of the group as are their resemblances and may be more important from an evolutionary point of view. The "characters in common" of static group concepts are replaced by determinations of central tendency and importantly supplemented by the study of dispersion. These concepts are essentially statistical, although it would be dangerous to give them that name before an audience inadequately acquainted with them. Some zoologists still think of statistics as a rather mysterious and very complicated mathematical game played with long lists of measurements. Statistical concepts, as the term is used here, involve a point of view that may be quite as pertinent to one observation as to a thousand and to a purely qualitative character as to a measurement.

It may be said that the statistical procedure is to describe the group as such rather than in terms of the individual, and it is superficially paradoxical to say that this restores the individual to the basic and essential position denied it in the older group concept, which often was expressed in terms of the individual. The paradox is, however, easily resolved. The statistical group concept seeks to take into account all the characteristics of all the individuals of the group, while reducing their description to collective terms. The archetypal group concept seeks to eliminate all characteristics by which individuals are distinguished, even though it may describe the residuum in individual terms.

Especially in the hands of paleontologists (although not yet by all of them), group concepts are also coming to have a fourth dimension analogous to the four-dimensional concept of the individual. To non-evolutionary zoologists, the archetype was divinely ordained and immutable except by subsequent divine renovation. The archetype-like group definitions of evolutionary zoologists had, of course, to be mutable, but the expression of phylogeny was really a succession of static pictures, like the Haeckelian concept of ontogeny. A phylum in time was recognized and defined primarily in terms of the common characters of all its species, just as the species was discussed in terms of the common characters of its individuals. But the particular sorts of groups to which the name phylum may be applied in a general sense include a time dimension. The secular changes that occur in them are as essential and characteristic as are their common or immutable features, and from an evolutionary point of view considerably more

important. Thus the concept of a phylum (or of any taxonomic group with perceptible extension in time) becomes dynamic, and it is better defined in terms of the changes that occur within it than in terms of its constant differences from other groups.

For the present subject the most important conclusion from this dynamic approach to taxonomy and phylogeny is corroboration and extension of the conclusions already drawn from evolutionary theory. The group is not an entity in the sense that the individual is an entity. A group achieves adaptation and progresses only in the sense that the individuals composing it do so. Satisfaction is an individual compulsion and not a group achievement. Evolution is not a thread on which individuals are strung, but a structure composed of individuals. A species is not a model to which individuals are referred as more or less perfect reproductions, but a defined field of varying individuals. A phylum is not a supermodel that abstracts the immutable features of a group of specific models, but a flowing river of ever-changing individuals.

#### THE INDIVIDUAL AND TOTALITARIANISM

*"The only government is that which makes a minute of individuals."*

"There arises a four-dimensional picture of the totality of life, with time as the fourth dimension, just as the individual gradually develops by growth from one cell all the organs that finally compose the complete body. The organs do not arise at random, but in the frame of the whole and some also degenerate before the whole body reaches maturity. In the development of the individual which in turn is only a subordinate part of the totality, an item is dominated by the unity of the whole, and in the same way the general evolution of life also exhibits a higher level of organization, an organic course of life."

"And now a final word about the future of society, the further evolution of the epiorganism. Unless the consistent indications of a great range of biological knowledge are all erroneous, the epiorganism will move toward increasing integration. . . . Units will become more specialized and interdependent, present epiorgans will improve in function and new ones will appear. The individual will be more and more a part of the whole state, though it will remain meaningless to ask the question, 'Does the citizen exist for the state or the state for the citizen,' since reciprocal influence is the essence of an org."

These passages were published at about the same time, in 1940, the first by a great German paleontologist, F. von Huene, and the second by a great American physiologist, R. W. Gerard. Both men, like others

before them, are comparing the individual within his society or group and an organ within the individual. Converging on this end from different directions, both reach the conclusion that the individual is part of a higher organism in the same sense that a cell or an organ is part of an individual. Both at least imply the proposition that the welfare of the higher organism, the epiorganism of Gerard, is of paramount importance in evolution and that the individual is to be viewed primarily as a subordinate unit. As far as his scientific work shows, the German quoted is as nonpolitical as one can be in Nazi Germany, and the American is outspokenly anti-Nazi, but the conclusions of both are sound totalitarian ideology. The question arises whether these conclusions are also sound biology, and in the world today consideration of the role of the individual in evolution can have no greater human value than by answering this question.

The transfer of knowledge and of judgment from one field to another is notoriously difficult, and one need not look far to find men eminent in one field who have made themselves ridiculous by posing as oracles in another. The biologist as sociologist, still more as political prophet or propagandist, runs a similar risk, but we are all necessarily concerned with social evolution. Whether or not they are really pertinent, biological theories are being used in this field, and the biologist necessarily has a part in the discussion, if only as critic.

The physical sciences have been accused of providing the material resources of war and oppression and their students have lately been on the defensive and most vociferous in endeavors to prove the accusation unjust. Now the biological sciences are being used to provide the more insidious and still more menacing moral implementation of totalitarianism. If this use is wrong, scientifically, and if free biologists support it or even tacitly permit it, then they will deserve an accusation stronger than any that can be brought against physical science and they will be contributing to their own destruction.

The analogy between the individual and society, or between organism and epiorganism (an *a posteriori* terminology that assumes the full validity of the analogy), is very old. Everyone has heard it, and most of us have used it as a figure of speech. When it ceases to be a figure of speech and becomes a basis for advice and action, it enters a new and more dangerous sphere and becomes subject to more critical examination and limitation. In this extended form the reasoning runs as follows: Cells and organs compose an individual. Individuals compose a society. The functional relationships of part to whole are analogous in the two cases. The evolutionary principles involved in the

integration of cells and organs into complicated individuals of increasingly higher type can and should be transferred to the political field as guides for the evolution of increasingly complex and higher types of society.

The biologist who accepts this argument soon finds that he is envisioning, perhaps even recommending, a society in which the individual is a specialized organ in a superindividual organism, in which, indeed, he is not an individual in the usual sense. The evolutionary analogy suggests to him that the epiorganism will and should evolve in the direction of greater integration (i.e., less individual freedom and responsibility), and that its units (i.e., you and I) should become more specialized (with less scope for activity and change), more interdependent (less self-reliant), and more a part of the whole state (less individual). (These conclusions, except for the parenthetical expressions, are paraphrased from Gerard). Then the biologist finds himself face to face with the fact that this is the totalitarian ideal. Of course, the politically totalitarian biologists accept the conclusion gladly and are strengthened and comforted by it. If, however, a biologist happens not to be politically totalitarian, he is likely to be shocked and to look for a way of avoiding his own conclusion.

The most obvious escape from this dilemma is to decide that totalitarianism is good or "basically progressive," as Gerard says, but that Nazism, for instance, is bad totalitarianism. The point is important enough to warrant brief examination of the more essential arguments given by Gerard and others.

Democracies are said also to be progressing toward integration, but aside from this general direction to be doing so in a biologically eugenic way while the existing totalitarian states are advancing in a dysgenic direction. That democracies are advancing toward integration in a totalitarian sense, except as they may be moving toward actual totalitarianism (for better or for worse), is open to question. Even supposing it true, their integration is different both in degree and in kind from an epiorganic structure. It is not at all in the direction of what I have called hyperzoan individuality and it is not totalitarian according to current ideologies.

The wrongness of direction of the existing totalitarian states is said to be shown by overspecialization, by isolation, by reversion to rule of force, and by deliberate excision of episenese organs. That the direction is wrong I most heartily agree, but these arguments are so easily refuted, if their analogical basis be granted, that they can only comfort the nations that they are meant to confound. Gerard gives the saber-



tooth tiger and the king-crab as analogies for overspecialization and as evidence that the Nazi epiorganism is doomed to extinction. The sabertooth specialization was, in fact, one of the most successful ever developed by a mammal. The machairodonts maintained their high level of specialization for conflict over a period of at least 30,000,000 years. True, they are extinct now, but the most probable reason for their ultimate extinction was the extinction of their accustomed prey. The analogy certainly does not favor the democracies! The king-crab is a worse example. This group has survived almost unchanged since the Triassic and is thriving now. Far from dooming it to extinction, its specializations seem almost to be a recipe for group immortality. But the example really has nothing to do with the case, because the totalitarian nations unfortunately are not withdrawing into a figurative shell.

As regards isolation, the argument seems to be going off at a tangent, because this does not really involve the organism-epiorganism analogy on which the rest of these conclusions are based. Moreover, it is not the totalitarian nations that are tending toward isolation in an evolutionary sense. Quite the contrary. They are the exponents and the present practitioners of expansion, migration, conquest of hostile environments, and competition with other epiorganisms—the very sort of activities that have produced the most potent and successful organisms in biological evolution. It is our own democratic country that shows a tendency toward isolation, the biological analogue of which has dysgenic results.

The integration of an organism is necessarily one of compulsion. What higher organism could function if a muscle reacted by its own free consent? Integration is only achieved by the fact that a muscle must react when told to and can have no choice in the matter. If society should be integrated in these organic terms, it is therefore meaningless to say that rule by force is bad. On these premises, it is not only inevitable and necessary but also biologically good. A truly integrated epiorganism can only function by force.

By the excision of episenese organs, Gerard means ideological limitation and official control of scientific and other intellectual activities. But from the totalitarian point of view there is no excision in this but only integration. The totalitarians can and do use the same analogy to demonstrate that they are not gouging out the eyes but are only making them focus and direct themselves in accordance with the will and needs of the whole organism. In an integrated organism there can not be any individual freedom of the parts. Only a diseased eye looks

where it will rather than where it is told to look. So in a perfect totalitarian epiorganism there should be neither freedom of action nor of thought, except in the unique leader, for these are symptoms of epiorganic disease. The biologist may conclude that he and his fellows should be the directive organs of the epiorganism and that the lesser breeds then do not need any freedom of thought or action, but experience shows that an epiorganism is more likely to differentiate its brains from housepainter-tissue than from scientist-tissue, and there is no evidence that the results would be very different in either case.

If totalitarianism is good, in itself, I see no escape from the conclusion that the present totalitarian states of Europe are fundamentally good and are on the best course of human evolution, whatever mistakes they may make on the way. (Democracies are not characterized by inability to make mistakes.) The organism-epiorganism analogy does logically and inevitably commend basic structures and principles of the states, whether Nazi, communist, fascist, or shinto, that accept totalitarian theories or practices. The democratic biologist who adopts this analogy in all its extension has no valid escape from the dilemma and no logical choice but to shift his allegiance.

The other alternative is to recognize that this use of the analogy is completely unsound. The relationship of the individual to society is fundamentally unlike that of the organ to the individual. The two relationships involve entirely different orders of things and do not belong in the same field of thought. As well say that electrons and their fellow particles compose silver, that silver analogously composes a photographic image, and then criticize the photograph because its pictorial composition is unlike the organization of a silver molecule. It is obvious that an individual is not an organ of society in the sense that a liver is an organ of an individual, but the very boldness of the metaphor and its wide applicability have made intelligent men forget that it is only a metaphor.

Such analogies are valid only as far as the two terms are well known and their analogical relationship is a matter of observation. Thus far they have descriptive value, but they warrant no extension to inferences beyond the field of observation. They have no predictive value and they do not permit transfer of knowledge and principles from one field to another. The biologist who elevates the organism-epiorganism metaphor into a standard for social interpretation and recommendation is guilty of the most reckless, unjustified, and nonscientific extrapolation.

A hyperzoan individuality, such as was mentioned in the introduc-

tory remarks, does not and can not possibly exist among mankind. A social group has no individuality according to the biological concept of the individual, and the extension to it of the same term is more likely to be confusing than enlightening. While exploring the analogy at least to, and I think somewhat beyond, the full extent of its validity, Julian Huxley has noted this essential limitation. "But," he wrote in the same journal as Gerard (*Scientific Monthly*) and in the same year (1940), "whereas the individuality of the body of a higher animal, cuttlefish, insect or vertebrate is far more developed than that of its constituent cells, that of a human society is far less so than that of its individual units. This fact, while it makes the analogy between cell and human individual almost worthless, is of great value itself as a biological analogy, since it immediately exposes the fallacy of all social theories, like those of Fascism and National Socialism, which exalt the state above the individual."

There is a true biological-sociological analogy, in part a true homology, and that is between the relationship of the individual to the evolution of species and to the evolution of social groups. I have failed in my purpose if the bearing of this analogy on the present state of human affairs is not now becoming clear. The group is a collectivity of individuals. It has no entity except as derived from the relationships of individuals. It does not evolve except as individuals change. It does not prosper except as individuals prosper, and it is incapable of satisfaction but is modified and perpetuated by individual desires and attainments of satisfactions.

The integration that has been progressive in evolution, that has led to higher types of life and that has been "good" biologically, or eugenic, has been integration of the individual. The ability of the individual to function freely, and in increasingly complex and varied ways has had survival value and has been progressive. Development of individual dependence and loss of individual versatility have usually been degenerative. In the line leading to man, the ability to form and to manage complex social structures has certainly followed the development of ever greater individual capacities and adaptability and, socially, a growing awareness of the rights of other individuals, which is the opposite of social subordination of individuals.

In this evolution it is clear that intrinsic satisfactions, as I have defined them on a previous page, have been dominant although extrinsic satisfactions have also played an important part. In addition to the profound error of supposing satisfaction to affect groups in a way different from the sum of the satisfactions of the individuals compos-

ing the groups, it is a characteristic of the totalitarian nations to emphasize extrinsic individual satisfactions at the expense of intrinsic. This is opposite to the emphasis that led to human evolution, physical and social, and if successful it seems biologically probable that it would lead not to a continuation of evolution to higher human levels but to a change of direction from human to nonhuman. The end of that different direction is exemplified for us by the social insects. I doubt whether even the most rabid myrmecophiles really want to live in a society patterned along those lines. In fact, it seems biologically impossible that the experiment can succeed, simply because we are mammals and were evolved as we were. We have neither the inheritance nor the genetic potentiality for making extrinsic satisfactions superior to intrinsic in survival value.

Biological justification for the totalitarian development of society has also been sought in the doctrines of evolutionary fatalism. Regardless of such labels as "right," "wrong," "good," or "bad," it is argued, this is the inevitable future. Mankind is going this way just as horsekind was going toward *Equus* throughout the Tertiary. Opposition is as futile and foolish as if the little *Eohippus* had said, "I am going to be a dinosaur," instead of "—a horse."

Even aside from the fact that this is another false use of analogy, it has been shown that a fatalistic view of evolution has little scientific support. It is not a probable hypothesis, still less a necessary one. A poet like Mrs. Lindbergh may urge submission to "the wave of the future," but a scientist may still believe that we are making our own future and that we have the capacity to make it to our liking and for the good of all of us as individuals.

The essence of democracy is belief in the importance and independence of the individual, and in the progress of society through the satisfactions of the individuals composing it. The essence of totalitarianism is belief in the unimportance of the individual and his subordination to the state, and in the progress of society as a thing in itself regardless of the satisfactions of the individuals in it. I believe with all my heart and head that the democratic principles are biologically sound and humanly eugenic, the totalitarian principles unsound and dysgenic. I believe that it is our duty, not as citizens of a democracy but as among the dwindling number of citizens of the world still privileged to live and think as individuals, to oppose the totalitarian fallacy and to maintain the true place of the individual in our social and in our biological philosophy.